A

DYNAMICAL THEORY

OF

THE UNIVERSE.

BY

JAMES TEALE.

MANCHESTER:

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ON taking a survey of the fundamental principles on which the various sciences rest, very serious discrepancies seem to arise between one and another, and instead of arriving at any general and fundamental principle governing the universe, they appear to be at variance; and each science built upon the groundwork of its own peculiar hypotheses, without regard to others, is in danger of diverging wider and wider from the truth, as its development becomes more complete.

As advancement is made in science, the two leading principles, conservation and order, appear in stronger relief. Order is universal; and conservation, by the persistent efforts of the philosophers of the present century, takes its stand by the side of order, and these combined form the groundwork of an harmonious whole. Granting that harmony is a law of the universe, there can only be one true method by which an explanation of the whole phenomena is presented to the mind; and when hypotheses clash with one another, there is good ground for further examination as to which is in error, or if both be not capable of further modification. If this be so, then a separate basis for each of the sciences must be considered an error.

A distinguished philosopher has said "hypotheses may often be of service to science when they involve a certain portion of incompleteness or even error;" but their continued use can only tend to propagate it; and if not held as provisional only, or until a more general organisation can be attained, they will result in failure, and throw the different sciences into confusion.

By the aid of mathematics, abstract truths have been worked out, and connected with the phenomena of Nature, in many instances; but there are others, in which, starting from wrong premises, the conclusions are in error; and it hence arises that, if correct hypotheses are not the basis, the resulting formula must be incorrect. Of this nature are the various attempts to obtain an insight into molecular physics. Abstract truths are useful in conveying a knowledge of the order in which a phenomena takes place, but do not convey any idea as to what the phenomena is; and where mathematics fail, recourse must be had to the foundation of all knowledge, viz., that which is obtained through the senses. Indeed it is a question, whether a reference to the phenomena presented to the mind is not a preliminary stage in the formation of any correct hypotheses.

The theory of light is an instance of this kind: the undulatory theory appears to answer all the requirements of the case, but undulations of what? The mind requires a medium as a necessary condition, and yet this medium is only known as the æther, and is treated in some branches of science as a myth, and ignored. Granting that light is motion, it must have as tangible a medium for its propagation as is required for the motion of any material particle, otherwise the mind can form no conception of its action.

Matter is said to be dead and inert, only to move when motion is imparted to it, and to have no power of stopping when in motion. On the other hand, gravity is a property of matter, and is called attraction, *i.e.*, the power of pulling other matter to it. First, it is impossible to conceive how any matter can attract, either without a medium intervening or with a medium; secondly, matter cannot be dead and inert, and at the same time have power to move towards other matter; and, thirdly, we have no idea of motion except in connection with a medium. Abstract motion is an entity which has no existence.

The origin of motion is called Force, an entity very convenient in mathematics for abstract reasoning, but conveying no definite idea, unless in connection with matter. Motion must be the motion of something, or have a medium for its propagation, otherwise it is quite incomprehensible. When motion is added to matter, it must be the addition of something or nothing; if something, then it must be from

some other medium; if nothing, then force is the creation of nothing, and can have no power.

Gravity may be styled attraction at a distance; and chemical affinity, attraction when in contact. On examining the relative specific gravity, and atomic weight of the elements, it is seen that there is a very great discrepancy between the two, and that combination does not take place according to specific gravity; but as specific gravity is said to be the sum of the mass, and is called a constant force, it can give no explanation of the act of combination, and as part of the chemical force disappears after combination, either two forces must be conceived, or gravity cannot be a constant force. Matter is said to be composed of hard and impenetrable particles or atoms. When a chemical combination has taken place, the compound generally occupies a less space than the two elements, but no explanation can be given as to what becomes of the difference which has disappeared, for a simple mixture of two bodies in the same state, does not change its volume until a chemical combination has been formed, and as the intermediate space between the molecules is filled with æther (if this substance exists in space) so this hypothesis would have to account for the displacement of the æther, if it be asserted that the atoms have been placed in closer contact, for it cannot be supposed that the æther is devoid of attraction, if it be also matter. Again, on applying heat to matter in the solid state, various elements require different quantities of heat, to raise them to the same degree, which is entirely at variance with the specific gravity; therefore an equal force opposed to another equal force, does not produce *pro rata* results. Heat added to matter expands for the same element, an equally increasing ratio for equal increments of heat to the melting point, then the expansion stops, and no effect is produced until a certain further quantity of heat is added; when expansion goes on again, and the same stoppage occurs at the gaseous point. If specific gravity, atomic weight, and heat be all constant, these laws do not explain the facts, and the theory of latent heat has to be added to that of specific gravity, with which it is quite inconsistent.

Atomic weight is said to be the size of the atoms, or rather the later theory of molecules, which is also supposed to be clusters of atoms, and consequently to have a constant force according to the theory of

attraction, but one atom or molecule combines with 1, 2, or 3 atoms of another substance. Theory gives no explanation of this deviation from constant force; it therefore appears by the light of these theories, that there are several forces, or there is no such thing as a constant force; even supposing two separate forces, specific gravity and atomic weight, they do not give any satisfactory explanation of the phenomena of matter, or if more than two forces were admitted it would still be impossible to give a consistent explanation, and adding isolated theories to the fundamental ones, is a deviation from that general harmony which is seen to exist in Nature.

Heat is said to be the motion of the molecules of matter, but it is not explained why the specific heats differ, or why one body should take more heat than another, when mass is supposed to be indicated by specific gravity, neither is the conductive power nor the rate of expansion explained by the theory. Electricity is called two fluids or one fluid, is now denominated a peculiar force, or motion, and to help out the other theories, matter is said to have different quantities at opposite sides of the body, and in order to explain the phenomena of electricity, other separate theories have to be added; in short, looking at matter as it stands, laden with all the different theories, we have a hetrogeneous mass of hypotheses, which clash with one another, and on the reasoning of mathematicians, stands condemned.

These hypotheses have been useful in connecting small circles of facts together, but having done their duty, any further development based upon them, must tend to lead future generations of philosophers astray, and thereby retard science.

Looking at the general facts of the Universe, and the theories promulgated to explain them, it is necessary to get out of the region of abstract ideas, and start on a fundamental basis, by inquiring into the method, by which we become cognizant of the phenomena of Nature.

It will be found on examination, that the knowledge obtained through the senses is not absolute knowledge. The senses convey to the mind certain impressions from outside, which are not acts of volition; and the mind transforms them into ideas, *i.e.*, definite conceptions, and upon the connection of these ideas depend the formation of hypotheses; we, therefore, have only a knowledge of

ideas, or the impression on the mind, and not a knowledge of outside things themselves, and the mind arranges these sensations into definite conceptions, according to certain fundamental ideas, which form the basis of all knowledge derived from sensation.

Space and matter are the two fundamental ideas formed from sensation. Space is a negative idea, signifying the absence of all sensation, and matter a positive idea of something that affects the senses. These sensations, varying in degree, constitute the ideas of force; and, whether it be called the potential pressure, or any other name, the idea force comprises the whole knowledge of sensation. The mind has the curious faculty of referring the sensation to the source whence it arises, and, as a gauge, measures out the universe according to the strength of the impressions received.

Form is the boundary line between forces of various degree, and traces out the line of demarcation between space and matter. Two senses take cognisance of form, the eye and the touch. The eyes, by reason of their binocular properties, gauge out distances, and the touch traces out form; and the sum of these two operations constitutes the knowledge of mass, but the whole phenomena is that of force and motion.

The boundaries of matter are lines of resistance, for light striking against matter rebounds to the eye, and the touch is not cognisant of form unless the mass is felt all over, and the mode is in some degree analogous to the action of the eyes; but in testing these lines of resistance it is found that three dimensions always remain in a constant proportion to each other, and from this property we get the ideas of matter. It follows from this that form can convey no idea of what space and matter are, beyond that of a boundary line, for the mind has to arrange ideas of sensation, and not the knowledge of things themselves; and to say that matter is hard and impenetrable, and space to be devoid of matter, is to mistake sensation for them.

The idea motion is obtained from the knowledge which the senses convey that these lines of resistance, or surfaces, are not constant, but changing their position relatively to other surfaces; and motion is inseparably connected in the mind with form, and whenever any motion is conceived it must be in connection with these surfaces, which is commonly called matter.

Abstract motion may be useful in mathematics in calculating powers, but conveys no definite conception to the mind, unless in connection with matter. But motion is the result of two opposing forces, one of which is greater than the other, or one force in which one part is greater than the other, and equilibrium is only attained when the two are intermingled, so that the force of one is equal to the force of the other; for, as the motion proceeds equally in all directions from any given point, the greater force is reduced until it becomes equal to the lesser force, and rest is the result, when both force and motion would cease to be manifest.

As motion cannot be conceived separate from matter, neither can force, and the ideas motion and force must be regarded as functions of the idea matter, and in this sense will be developed in the following pages.

Time is an idea of measure—the measure of one motion by another; and when it is said that the motion of a point takes so much time, nothing more can be inferred than that it is measured by some other motion, and likewise weight, in the same manner, is the measure of force. Of absolute motion, or force, it is impossible to obtain any knowledge whatever.

Absolute rest has no existence; therefore Newton's law of a body at rest must always remain at rest, or in motion remain in motion (or the doctrine of inertia) is not an explanation of this; but relative rest is the idea formed in the mind, when the lines of resistance of two bodies remain stationary with regard to one another. The idea relative rest may be formed in two ways; first, when two bodies are in motion, if a parallel motion and uniform, they are at rest with regard to one another; and, secondly, when two bodies are placed together, and are impressed with two equal and opposite forces, the state of balance will produce relative rest, whatever be their combined motion. It is to this relative rest that Newton's law must be applied, for if there were only one body, or one force, we could form no idea of either rest or motion; therefore statics is based upon equal and opposing forces, and geometry is the law of such a system of relative rest; but dynamics being the laws of force, must be the basis of statics, as relative rest is compounded of the laws of force.

As the mind only knows the sensation of force and motion, and not the phenomena itself, it is vain to enter into any theories as to their cause, which must for ever remain beyond the reach of human intellect. Abstract causation is entirely inapplicable in science, for the interchange of force and motion constitutes the whole sum of physical phenomena.

The inductive and deductive method is the law of action of the mind, by which the impressions received through the senses are arranged so as to agree with the fundamental ideas, viz., space, matter, force, and motion; and in forming a universal theory, it is important to recognise that it is a theory connecting ideas derived from sensation, and not of outside things, or absolute knowledge, as already laid down. The relative method, which has been used in developing the following theory, is an addition to the inductive and deductive method, in so far that it takes the Universe as an infinite whole, and seeks to discover the relation of the different parts, based upon the fundamental ideas, and ignores entirely the obtaining of any absolute knowledge through the senses.

As the mind is only capable of forming finite conceptions, viz., in space, all theories must be formed under finite condition. Infinity is beyond the comprehension of man, for the finite can never comprehend the infinite, but the idea infinity may be used in a limited sense, as signifying an unknown quantity containing the finite, and in this sense is of practical value.

THEORY.

The Universe is infinite, and filled with a medium which may be called Matter, and also the Potential. The change in the directive action of this power constitutes Motion, and the action itself Force; force and motion are, therefore, manifestations to the senses of matter, or of power. That which is ordinarily called Space and Matter, contains the same quantity of this medium, and the phenomena of motion and force arises from this power not being in equilibrium with its several parts. Although each portion of matter exerts the same absolute amount of force, yet the force is exerted unequally in different directions, and the endeavour of one portion to attain equilibrium with another, is the cause of motion.

If infinite Space, filled with this medium, was in equilibrium, no motion, force, or other phenomena, would be perceptible, or if a portion of this medium was abstracted or annihilated, then the remaining medium would spread out, filling the space until equilibrium was attained, but the sensible phenomena is not produced by this method, for there is no absolute transfer of this medium from one place to another, as space is immovable, and space is another term for this medium, although it has here been called matter, in order to convey a definite conception, in ordinary language, for the ordinary idea of space—a place with nothing in, has no existence—but in order to convey clear ideas, the term matter filling space will be used.

In a medium equally filling space, the only primary motion possible would be a vortex motion, and such vortex systems are the foundation of what is ordinarily called matter. Helmholtz has shown that a vortex filament has no power of destroying its own motion, that once formed, it must continue in motion, until destroyed by some outer force. Ordinary matter may be described as vortex systems of motion in the midst of infinite motion, or nuclei of force in the midst of infinite force, according to the phenomena being regarded as motion or force.

If the motion of a vortex system were increased, the force contained in the vortex system would offer less resistance to outside pressure, as the same element of force could not exert itself in two places at once, and by reason of their being conservative, they would have the same effect as if they were portions of space, but with this difference, that the matter, which was not in such vortex systems, could not enter into this space, and two of such systems, whatever their distance, would be forced by the surrounding matter towards one another, until they met, and the force exerted would be the square of the distance, as the power of a given point decreases in this ratio, and is synonymous with the geometric law, that the figure of a sphere increases or decreases, as the square is to the cube of its contents, and this is the foundation of Gravity.

All knowledge of ordinary matter consists in lines of resistance, or the separation of one vortex system from another; and the intermediate space is also filled with matter, which is not in vortex systems, but exists simply as power, and is the medium of motion between the various vortex systems.

We shall first consider ordinary matter, or vortex systems in general. The most perfect vortex system would be a sphere, in which the greatest amount of force was transformed into motion, in a circular direction, or a line returning into itself; and the force withdrawn to produce vortex motion could not act as a repulsive force to a force outside the boundary of this line, as the same element of force cannot act in two places at once; and such a sphere would appear to have the greater amount of attraction, by reason of its resistance not being equal to the outside force, and in accordance with the velocity of the vortex motion would the action of gravity be greater or less. But attraction is an idea which has no existence in Nature: the whole phenomena can be classed under the head repulsion, which is force. Gravity, therefore, is not attraction, but arises from the repulsive force of vortex systems being withdrawn to produce vortex motion; and as a straight line between two bodies is the shortest distance, when every direction is infinite, so the outward power in what is called space would force these two bodies together in straight lines, at a rate, first, according to the conversion of repulsive force into vortex motion, and, secondly, at a velocity increasing as the square of the distance, to agree with infinity in all directions.

When two vortex systems come in contact, they will destroy one another; and the vortex motion being retransformed into a force of resistance to outside pressure will cause spherical waves of motion to set out from the points of contact, and proceed outwards in all directions; and the force of these waves, as they proceed, will diminish as the square of the distance—it being the reverse action of gravity. The phenomena of these waves is known as Heat. The matter which is in space exerts its force equally in all directions, and is in equilibrium with itself, but not with the vortex systems.

Primary motion consists in the conversion of force into vortex motion, and secondary motion is caused by the force of gravity; the converse action being the re-transformation of vortex motion into force, and heat force the cause of secondary motion. Thus force and motion may be said to be attributes of space.

We will now consider the phenomena of force and motion as it exists on the earth. It is probable that ordinary matter does not consist of single vortex systems, but of clusters, which revolve round

one another, and to which the name of molecule has been given. A molecule is always under the influence of two forces, the force of gravity and the force of heat, which latter is derived from the sun; these are opposing forces, acting on the molecule, and their contending influence produces the varied motions of the molecules.

As it is not known how the molecules of the elements are formed, whether first from single vortex systems into the different elements, or in one grand succession from one element to another, the idea element must only be taken as provisional, meaning that no further decomposition has been effected.

The diverse action of gravity on the molecules of the elements is caused by the different quantity of force which is transformed into motion in the vortex systems composing them, and would be an index of the vortex motion if the molecules were not under the action of the heat force; for gravity is opposed to the force of the molecules, minus the velocity of vortex motion, plus the heat force which has entered the molecules, and the heat force in the intermediate space. Specific gravity is not therefore simply the mass of matter in a given space; for the greater the specific gravity of a given space, the greater will be the velocity of vortex motion, and the greater the number of molecules in that space; and this will be modified by the quantity of heat force passing through, their size becoming larger and number less according to the addition of heat.

The heat force which is passing through a body alters the form in three states, viz:—In the solid state, the molecules appear to oscillate, and not to make complete revolutions on their axis. On examining the crystals of solids, it is a noteworthy feature, that in general, the projecting angles are wanting, and appear as if a cube, or other perfect geometric form had been made to revolve and the edges ground off, and there is good reason for supposing, that these, on their fundamental type, are representative of the form of the molecules, and that it is produced by the friction of one molecule against another in the act of solidification, when a considerable quantity of heat is thrown off. In the liquid state, they appear to be in a more spherical form, and the heat force, which is expelled in the act of solidification, is again absorbed into the molecules, in the act of liquefaction, and they become larger, and not only rotate upon their own axis, but

revolve round one another, under the contending influence of gravity, and heat. At the point of change into gas, the molecules have reached a stage, where their force is greater than the pressure of the surrounding gaseous media, such as the atmosphere, when heat again enters into the molecules, and they expand to a still larger size, and their molecular motion is increased.

As the force in the molecules is an opposing force to the force of heat, the greater the quantity of heat passing through them, the greater will be the length of their angular motion, in the surrounding media, and the longer period will they require to perfom it in; hence molecules in the solid state, will make quick, and short oscillations, and in the gaseous state, long, and slow excursions from one another, and also revolutions on their axis. As the whole Universe is endeavouring to attain equilibrium, the additional heat force passes out of the molecules, and becomes dissipated in the surrounding space, and the molecules tend to their normal form, as they appear under the influence of the heat of the sun.

CHEMISTRY.

Chemical combination is the forming of larger clusters of vortex systems from molecules of two or more different periods of vortex motion.

In order to effect combination between two bodies, it is generally necessary to bring both into a liquid or gaseous state, so that the molecules may intimately mix with one another, and if the molecules are of different periods of vibration the angular velocity of one system will interfere with the other, if the heat force is not sufficiently great to keep them clear of one another, for the action of gravity forces the two in contact, and the molecules are partially destroyed, heat being thrown out, and an equilibrium established between the two systems.

Every chemical combination has its special limits of heat force, within which the combination takes place, and a compound may be formed at one temperature and destroyed at a higher, for the heat force entering into the several systems of the molecule in different proportions, enables them to break loose at higher temperatures. In the same manner a third body, by combining at a lower temperature with a compound, and by the heat force which is thrown off during

the act of combination, may so increase the size and motion of the second body as to force it off, and leave the first and third body in combination, or, if the heat force is not sufficient, the whole will remain in combination. Decompositions are effected in this way, and according to the degree of heat passing through a mixture will a compound be formed, destroyed, or prevented from forming.

That which is called heat is the matter released from the vortex systems, in the act of combination, which, regaining its full force to outside pressure, throws off spherical waves of heat force from the points of combination; the resulting compound generally occupies a less space, having a greater density and less specific heat than the sum of its elements.

The character of chemical combination is so varied that in the present stage of science it is impossible to do more than lay down the general principle of combination as it takes place on the earth.

The molecules of a body with the same period of vibration would come in contact and destroy one another, if it were not for the heat force of the sun; but there are a few instances of the molecules of a body partly destroying one another, and producing compounds, which are known as the allotropic condition of certain elements: these are destroyed by heat, for it acts as if it was an addition of matter to the molecules, and enables them to regain their normal condition.

Although part of the heat force which is thrown out of a combination may be returned to another set of molecules, yet the greater part ultimately finds its way into space; and the original elements never regain their former size from their own heat force, but must take it from some other body combining and throwing off a greater heat.

The molecules of matter are gradually being reduced in size, and taking the form of matter in space, but little or no change is noticed on the earth; for any condensation which takes place would bear so small a proportion to the whole mass that it may escape observation, and the sun, being a source of greater heat, compensates in a great measure for the loss of heat in chemical combination.

The primary formation of the motion derived from heat force is, therefore, chemical combination in some form, or the re-conversion of

part of the vortex systems into the matter in space. This motion is capable of being carried from molecule to molecule, and from one solar system to another, by means of this medium.

The molecules of matter assimilate a different proportion of heat force than the matter in space, according to their size and vortex motion; hence the relative heat of bodies differ, or different quantities of heat force will be required to produce *pro rata* results. The relative heat represents the quantity of heat force which enters the molecules in a given space, and gives the equivalent of force opposed to it. The specific heat gives the equivalent of available force opposed to gravity in the molecules, or may be regarded as the equivalent of untransformed force; for that portion of force in the molecules which has disappeared to produce vortex motion is replaced by the force of gravity; thus force which disappears at one point reappears at another.

The atomic weights give the relative equivalent of available force in one system of molecules to another, so that a multiple of the atomic weight, and specific heat, gives a constant number, or force; and combination takes place in these proportions, in multiples of them, or equal parts.

As the specific gravity does not indicate the mass in a given space, but the amount of vortex motion, etc., or the relation of force in space to force in the molecules; so the atomic weight does not indicate the weight or number of atoms, but is the relation of available force in one system of molecules to another.

Using the atomic weights of the older chemists, and dividing them by 9, we have a ratio of comparison between the specific gravity and atomic weight, viz., H O = 1 for specific gravity and for atomic weight. A table of the elements made on this basis shows that those elements which have the greatest chemical affinity have the least specific gravity and atomic weight, and the least difference between the two; and as the specific gravity increases over the atomic weight, so does the difficulty of their combining increase. There are certain metals of which the multiple of the atomic weight and specific heat gives double the normal value; and on turning to the table here mentioned, it will be seen that they are altogether out of place,—that with the atomic weight given, they are all of a less specific gra-

vity than atomic weight; but if the atomic numbers are halved, they take their proper place in the list, according to qualities. The same also applies to some of the non-metallic elements, when reduced, or increased, to the scale. It thus appears that the true normal combining numbers are those which give a constant result when multiplied by the specific heat.

The difference between the specific gravity and atomic weights also gives a general relation as to the melting point, expansion, and conducting powers of the elements; for the greater the difference between the specific gravity and the atomic weight, and the greater the specific gravity, the greater will be the conducting power, the higher the melting point, and the less the expansion; and on reversing these conditions, so will the qualities be reversed. In a single element the specific heat differs in three states, it is least in the solid state, greater in the liquid, and greatest in the gaseous state.

Although such a list as here described agrees with the general qualities of the elements, yet there are minor discrepancies, which cannot be explained, and will not be, until a greater range of experimental basis is attained. At present no one table of numbers can be made to agree with any other in all its details; for instance, the order of expansion of metals is not in the same order they conduct heat or electricity, neither does it agree with the specific gravity, nor the specific heat, and so of tables of the other properties, placed in their order; but a general relation of the whole may be traced out in the present stage of science, and as experiments become more exact, many of these internal discrepancies will disappear, as is the case, in the tables of conductive power of metals for heat, and electricity.

If an estimate could be formed of the quantity of heat force thrown out, in the act of combination, it would probably elucidate many of these internal discrepancies.

The effect of heat in a given space, is simply expansion, first by increasing the distance between the molecules, and secondly by increasing their size, and reducing the proportion of vortex motion to force. This heat force passes out of the molecules into the matter in space, and is propagated through it in a uniform ratio, according to the laws of radiant heat.

To enable a body to crystallize or combine with another, it must

be brought into the liquid or gaseous state, for unless the molecules have free motion round one another, they would not be in a position to assume those characteristics, which constitute a crystal, or chemical combination.

The effect of the abstraction of heat from a body, or cooling, is contraction; the molecules occupying less space. If cooling could be carried on indefinitely, either a point must be reached where no further contraction takes place, or contraction must go on until the molecules are dissipated; but considering the molecules as clusters of vortex systems, expansion and contraction are only relative terms, signifying the disappearance of force in one portion of space, and reappearance in another.

LIGHT.

The phenomena of light is of the same nature as that of heat, but with the difference, that the senses receive the impression of heat not only from the matter which is in space, as radiant heat, but also from the molecules, by conduction, whereas the sensation of light is derived through the medium of the so-called æther alone, which is synonymous with the matter in space, but the source of both is the same.

As the molecules are receiving heat force, their own rate of excursion is increased, and also the rotation on their axis; they first impart to the æther waves of long period (known as radiant heat) which is caused by the extent of excursion of the molecules from one another, and also waves of shorter period, which affect the eye as light, and is caused by the rotation of the molecules on their axis; this phenomena increasing with each accession of heat, until the light and heat become too powerful for the senses, when the tissues are decomposed. The Undulatory Theory expresses the laws of the propagation of this force through the æther, and is true of radiant heat, as well as light.

The theory of colour is involved in the chemical constitution of the retina, and with the laws which determine the action of light upon the molecules, in the production of chemical change.

Chemical compounds are described as stable or unstable, easily disturbed, or otherwise, when heat is added, and, according to the strength of the vibrations of the æther will compound bodies be

affected. The waves of light having little force, and very short periods of vibration, are not able to move the whole mass of a body, but falling upon an un-stable compound, one whose balance is so nicely adjusted that either of the elements receiving an undue accession of motion, overthrows the balance, and decomposition is the result; of this nature is the change produced in obtaining photographs. The waves of a certain period affect the molecules of one system in a greater degree than the others, and are enabled to break loose, as in the decomposition of bodies by heat. In the same way the waves of light, falling upon the retina, produce chemical decomposition, which knowledge is transmitted to the brain by means of the nerves. The periods of vibration, answering to the colours, falling upon the retina, affect decomposition of its substance, which is continually being renewed, and the time the sensation lasts, is the period which the retina requires to renew itself.

The waves passing through the spectrum, have been divided into the heat, light, and chemical spectra, and is here described as a gradation in the wave length of the æther. The maximum of heat is that particular length of vibration which produces the sensation of greatest heat; the maximum of light is that which affects the retina in the greatest degree; and the maximum of chemical decomposition is that which has the greatest effect on chemical substances used in producing photographs. At points below these maxima, the vibrations have not the power of effecting their particular decomposition, and it will probably be found that each compound has its own particular range, below which decomposition does not take place.

The transparency or opacity of a body is indicative of the closeness in which the molecules are placed with regard to one another. When the vibrating waves arrive at the surface of an opaque body they are instantly changed into vibrations, corresponding to the wave length of the colour given out, which is reflected, and the remaining motion goes to increase the movement of the molecules. Waves arriving at the surface of a transparent body are partly reflected, partly absorbed, and changed into molecular motion, and the remainder passes through; but that part which is transmitted is changed in direction by the form of the surfaces of the body. When they are parallel, the motion

passes through in nearly straight lines; but if not parallel, the waves are thrown together in such a manner as to produce the phenomena of interference. The so-called analysis of the prism is explainable by the laws of interfering rays, and the colours are produced in the same way and order as the colours in Newton's rings, and on thin bubbles. Refraction may be styled internal reflection, and it is at the second surface, or surface of exit, where the phenomena of interference is manifest, by the inclination which it has to the first surface. The waves of light passing through a denser medium are retarded in their progress by this internal reflection, and on coming out of the denser medium into a rarer one, through a surface inclined to the first one (as in the prism), they take up their accelerated motion again, and while in the act of doing so, those waves which have not been accelerated are thrown on to those which have just left the surface, producing the phenomena of interference. The prism or other transparent body has not the power of reducing the wave lengths corresponding to the three primary colours into waves of other periods; therefore the conversion is only a partial one, and shows there are three primary classes of waves, whose motion is not interfered with by the medium through which they pass, when reference only is made to form; but these waves are reduced to waves of longer period in another way. As they pass through a medium, they are continually parting with some of their force to the molecules, and increased thickness gives longer waves. There are many instances which show this. Muriate of chromium and sap-green in small thickness is green, in greater ones red; cobalt glass and tincture of violets is blue in thin strata, and red in thick; and so of other cases, showing that increased thickness produces longer waves.

Wave lengths of a certain period cannot be changed by reflection or refraction into waves of shorter periods, but always into those of longer period, and are ultimately absorbed in the form of heat. On the other hand, by heating the primary molecules, the red, or wave of longest period, appears first, and on increasing the heat the waves become shorter and shorter, until white light is produced, which is the smallest form of vibration that the eye can bear.

In this manner the same agency produces heat and light; colour being the sensation of motion, in the same manner that heat is the

sensation of motion ; the one effecting decomposition of surfaces, the other of masses, and failing decomposition increases the vibrations of the molecules acted upon.

ELECTRICITY.

The phenomena of electricity is the vibration of the molecules under certain conditions, which distinguishes it from the motion of heat. The difference between heat and electricity consists in the altered conditions under which the vibrations are propagated rather than in any definite change of character. The vibratory waves in homogeneous bodies produce the phenomena of heat, and in heterogeneous bodies that of electricity.

The conduction of heat stands in the same relation to that of electricity as the internal motion of gases bears to the motion of masses ; the one is vibrations in all directions ; the other, vibrations in one particular direction.

The motion of the molecules under the contending influence of gravity and heat may be divided into two classes—first, vibrations, which are the partial or total revolution of a molecule on its own axis ; and, secondly, molecular motion proper, which is the distance the molecules recede from one another under the influence of heat. Those elements which have the greatest specific gravity have the greatest number of molecules in a given space, which are held close together by gravity ; the heat force is therefore opposed, not only to a greater vortex motion in the molecules, but to a greater number of them. The first step in applying heat force to a body of large specific gravity will be to make the molecules revolve on their axis ; but if the molecules are so close as not to permit an entire revolution, as in a solid, they will oscillate to and fro, passing the heat force from one to another. In the case of heat these oscillations take place in all directions, but in the case of electricity in one particular direction, and these vibrations are communicated ultimately to the æther in space.

The greater the distance between the molecules, the less will be the vibratory motion, or conduction, and the greater the molecular motion : thus liquids and gases will be bad conductors ; for in these cases vibrations are changed into rotatory motion, and at the same time the molecules are retained, so far apart as to revolve round one another.

Bodies of light specific gravity and transparent bodies have their molecules separated, so that their motion is partly vibratory, but principally molecular motion, although this latter does not extend so far as to allow the molecules to revolve round one another.

Taking the scale of the elements, we have a series commencing with bad conductors, and advancing to the best conductors, and as the character of the vibrations from molecule to molecule is the same, both in the case of heat and electricity, so the tables of conductive power should be the same, and later research has proved this to be the case.

The distinguishing feature of electricity is a circuit of good and inferior conductors, surrounded by bad conductors. When heat is added to any point of a ring of metal, the vibrations of the molecules increase equally in both directions, and are communicated to the surrounding molecules, and to the æther; but if a ring of platinum wire be tied in a knot at one point, that portion which is knotted has its molecules brought in closer contact, and on heating near this knot, more vibrations pass through it than the other way, and the easiest course to produce equilibrium is round the ring, and this is the origin of the electric current.

Polarity means nothing more than direction, in which the major current is flowing, viz :—From the positive to the negative pole,—a pole being understood as points in a circle, but the molecules themselves have no poles or polar forces in the sense generally used.

In the case of a circuit of dissimilar metals, say, a thermo-electric pile,—when bismuth and antimony are heated at the junction, each of the metals are receiving heat force, but one metal is accepting and transmitting, a larger proportion of force than the other, thus an unequal balance in the circuit is produced, and a wave current of vibrations sets in from the best conductor, to the one which does not conduct so well; for although the metals are radiating, at every point, heat force into the surrounding medium, yet the atmosphere is an infinitely worse conductor, and the force is conveyed by preference to the next best conductor in greater part, and this phenomena runs through the whole of electric science.

The first transmission of heat waves through a body is not so apparent as when they take the form of electricity, for in the

galvanometer we have an instrument of surpassing delicacy, and although the thermo-electric pile is used to show the transmission of heat, yet this force must be changed into the character of electricity before it does so, and the indication of electricity must be far more delicate than heat.

In the galvanic battery we have also a circuit of good and inferior conductors. Taking a common form of battery for illustration, there is a liquid chemically combining with a metal; from this metal extends a good conductor, to another metal not capable of combining with the liquid, and the whole is surrounded by bodies which are bad conductors. When a liquid is entering into chemical combination with a solid, the molecules of the metal are detached consecutively, and form a solution in the liquid. In the act of combining, part of the force is thrown out of the molecules, in the manner already explained, which is taken up by the water, or liquid; but the molecules of the metal, in order to combine, require a supply of force in addition to what they have in the solid state, in order to dissolve (as it is well known that solids dissolved in liquids produce cold), and this supply they take from the metal itself as the best and nearest conductor. The combining metal is thus robbed of its heat, and it in turn takes it from the next best conductor, which is the metal immersed in the liquid, and connected with the first metal; meanwhile, the chemical compound is giving off heat, which is taken up by the molecules of the liquid, and transmitted to the two metals, but the metal, which is not in the act of combining with the elements of the liquid is ready to accept, and transmit, a far greater proportion of the force than the other metal, and a determining current of wave vibrations set in from the place of combination to the positive metal, through the intermediate series of molecules of the liquid; one part of a compound molecule, combining with the first metal, and the second thrown off to the next molecule, which in its turn parts with its second half to the next, and so on until it reaches the positive metal, to which it imparts the force, or in the case of gas being evolved, partly to the metal and partly to maintain the gaseous state. In this manner a determining current of wave vibrations is transmitted, from molecule to molecule, through the circuit, and the force gets ultimately diffused through the liquid and the metals, showing itself as heat.

The action of a closed current, not having any work to perform in the shape of other decompositions, results in the gradual heating of the liquid. If this current is retarded in a conductor, it again shows itself as heat; for, the conductor not being able to transfer the force as fast as it is received, the character of the current is changed into vibrations in all directions within the mass of the conductor itself, and in this way the vibrations of the molecules themselves produce the phenomena of heat, or electricity, according as the conditions are altered.

That the electric current is propagated in the form of waves, from molecule to molecule, is seen "when a lead wire in a state of fusion is followed up by the terminal wires of a battery: it gathers up into nodules, which press on each other like a string of beads of a soft material which has been longitudinally compressed;" and also in the Geissler tubes, the light, passing between the two terminals, is seen to move in a vibratory manner backward and forward.

If another decomposable liquid is placed in the circuit, decomposition is effected in the same manner that heat does, by unequally increasing the motion of the molecules of which the compound is formed; for as heat, increasing the motion of the molecules to a given standard produces combination, or increasing the motion beyond that standard produces decomposition, so electricity does the same thing, under the conditions in which the molecules are placed, for in this case the force is limited to a small space, and proceeds in a given direction.

If a bad and good conductor be placed together, and electric vibrations imparted to the good conductor, this conductor gives off to the bad one vibrations which gradually make progress through it, and ultimately into the æther, and the electricity is said to be dissipated; but if a bad conductor is receiving more vibrations than it can transmit (say by friction with another bad conductor), they accumulate on the surface, and if a good conductor is brought in contact, it will part with its surface vibrations to the good one, producing the phenomena of machine electricity; but this form of electricity is owing not only to friction, but partly to oxidation of the amalgum, and partly to the supply of heat force taken from the earth, to replace that which is removed from the negative conductor, by the revolution

of the glass, which latter readily parts with it to the positive conductor on the opposite side in the form of electricity. If the negative conductor is insulated the supply of force from the earth is cut off, and the electricity is derived from the action of friction and oxidation.

If two good conductors are placed together with a bad one intervening, the phenomena of induction is manifest. The second good conductor is able to take from the bad one more vibrations than this latter would impart to a similar body, and thus increases its conductive power; and, this re-acting on the first conductor, it imparts a greater quantity of vibrations in that direction, and the plus and minus states of tension are produced in the two good conductors; the first flow of a primary current through the first conductor producing its corresponding effect in the second conductor, as seen in induction currents. It is the influence of gravity retaining the molecules of bad conductors round the good ones which confines the electric current to its course.

When a break is made in the circuit, and the current is sufficiently strong, it detaches some of the molecules of the metal, or electrodes, and carries them across the space to the conductor. If the receiving conductor is a polished plate, the vibratory character of the current is seen in the stratified discharge. During the passage of the molecules from one conductor to another the phenomena of light is manifest; the molecules then, being free to rotate freely on their axis without coming in contact, impart the highest form of vibrations to the æther, in the same manner that heat produces light.

If a gas between the two conductors is rarefied, and electricity passed through, the spark is changed for a glowing light; and the intervening molecules of the gas, by their rotation, are enabled to impart a larger proportion of waves to the æther, as there are less molecules in the space to impede the vibrations. The stratified light produced in rarefied air is derived from the increased rotation of the molecules of the air, and the electric light from the increased rotation of the molecules detached from the conductor. Electric waves travel along a conductor with a velocity which increases with the source of the current, and the two ends of wire must be in a plus and minus state until the current is equal throughout when it will be transmitted with a definite velocity.

Electric attractions and repulsions are produced when two bodies of sufficiently light material are insulated and supended near one another. On an electric charge being imparted to one of them, the first result is to throw the molecules into increased vibration, which are given off to the surrounding medium. The second body, which is the nearest conductor, increases the conductive power of that portion of the æther between the two, and the vibratory motion is received by the second conductor, and transmitted to the opposite side; but, meeting with resistance from the atmosphere, is reflected, and the whole body is repelled towards the first, in accordance with the known laws of motion. The first body having also its state of vibration reduced, on the side next the second conductor, is impelled towards the second body. When the two meet, and are reduced to the same state, repulsion sets in, for their outer sides are giving off force to the æther, while their adjacent sides are repelling one another, and they are separated; and this will be repeated until the vibrations of the two bodies are reduced to that of the surrounding medium, when the electricity is said to be dissipated.

The phenomena of electricity is thus of the same character as that of heat and light, but differing, in the mode of its propagation, in accordance with the altered position in which the molecules are placed.

MAGNETISM.

The magnetic condition of certain bodies is the result of a change in the direction of the vibrations of their molecules. They, being always under the influence of heat, are giving off and receiving vibrations from the surrounding medium in all directions, and this is the state in which an unmagnetised mass of iron is placed; but if the molecules are so arranged that all the vibrations are transmitted in one particular direction, the phenomena of magnetism is manifest, and the iron may be said to transmit within its substance closed currents of electricity.

By whatever method permanent magnetism is induced, a certain time is required for the molecules to change their position from vibrations in all directions to vibrations in one particular direction; and this is evident, as time is the measure of one motion by another.

All magnetism is produced by induction, i.e., receives its directive impulse from some other body whose molecules are vibrating in a circular direction, and which vibrations are transmitted through the æther in the intervening space; for a body cannot act where it is not, or produce attraction or repulsion, unless the impulse is transmitted through the intervening medium, which is in contact with both bodies. But, in order to explain the phenomena of magnetism, it will be necessary first to consider that of electro-magnetism.

The electro-dynamic cylinder of Ampère satisfies all the conditions of a magnet; this cylinder being a helix, with a current of electricity passing through the wire, and showing all the phenomena of magnetism.

As the current of vibrations is proceeding down the wire, round the imaginary cylinder which the wire represents, it is at the same time giving off to the surrounding æther vibrations, which are not thrown off at right angles to the axis of the cylinder, as would be the case if the vibrations were of the same nature as those of heat, but proceed outwards from the circumference of the cylinder, and in a direction corresponding to that which the current in the wire is taking, and a vortex system of vibrations is created in the surrounding medium, and, if a susceptible body is near, transmits to its molecules vibrations in the same direction. Iron appears to be a body whose molecules are capable of altering their position, so that they shall vibrate in the same direction as the inducing current.

If a bar of iron be placed parallel to the axis of the electro-dynamic cylinder when a current of electricity is passing through the wire, the bar is in a position to receive the wave currents in the manner described, and they, impinging on its surface in one determining direction, set up in the molecules of its mass a continuation of this motion, in the manner that motion is transmitted from the edge of one wheel to another. Thus the adjacent surfaces of the cylinder and the bar will have the current proceeding in the same direction, and in the outer surfaces proceeding in the same direction with regard to one another, but in a contrary direction to that of the adjacent surfaces.

By this method the molecules of iron are placed in a position to show the phenomena of magnetism, whether the current be derived

from a battery or from the earth. That end of the helix which is called a north pole will have adjacent to it in the bar a south pole, for if the bar were removed, still retaining its magnetic condition, and that end which was adjacent to the north pole placed at the other end of the helix, and in a line through the axis of both, the current of vibrations in the helix would be in an opposite direction to that of the bar; and in order to bring the direction of one in conformity with that of the other, it would be necessary to turn the bar round and place its other extremity, or north end, to the southern pole of the helix; and this is the origin of the term magnetic pole, which means those ends which have a vibratory current proceeding in the same direction, and are north or south poles according to the direction. If a soft iron bar is placed within the helix, magnetism is induced under the same laws, the difference being only in position.

A permanent magnet is a mass of iron whose molecules are in combination with some other element, which compound has considerable difficulty in returning to its normal form of vibration, when once changed in direction, and the length of time required to magnetise or demagnetise, such a body is indicative of the resistance offered. Whatever is the method employed to obtain a permanent magnet, the body must first be placed in the position to receive the inductive influence of such a current as is here described, and if a vibratory tremor be imparted artificially to the body while under the influence of induction, it assists the molecules to change their direction. Steel appears to have this property of retaining the molecules in their directive position when once changed, so as to produce the phenomena of magnetism.

Changing the helix and the bar, for two sufficiently light permanent magnets, and placing them parallel to one another, and at a short distance, they are in a position, to show their mutual attraction or repulsion. If the north pole of the first magnet has adjacent to it in the other magnet, a south pole, and the other ends *vice versa*, the current of vibration within the two magnets is proceeding in the same direction as in the helix and the bar, and if the direction of the vibrations in the adjacent surfaces be, say to the left, vibrations are communicated to the æther laying between the two magnets, in the same direction, and outwards. If the lines of force are traced from

the two magnets, they will meet at points to the left of an imaginary line connecting the centre of each magnet, and which may be called the points of resistance, and these, meeting to the left of the centre of gravity, reduces thereby the pressure on the adjacent surfaces, and the pressure of gravity on the outer surfaces remaining the same, is enabled to force the two magnets together, and produce attraction, for if the pressure between the two bodies is reduced, they must come together unless some greater force holds them in other directions.

If one of the magnets is turned round and placed in the same position, a north pole is adjacent to a north pole, and a south pole to a south pole. The vibrations in the adjacent surface of one is the reverse of the other; and if the lines of force are extended in the intermediate medium, the points of resistance will meet at a tangent crossing the line joining the centre of gravity of the two bodies, and one set of vibrations is the exact reverse of the other. The effect will be to increase the force in the intermediate space and produce the phenomena of repulsion. This is the fundamental principle of magnetic attraction and repulsion; and all other motions of magnets are compounded of these two, according to the different positions in which they are placed.

Although the force is transferred to the æther in the manner described, yet it is not given off in an equal ratio along the entire length of the magnet. The bar itself (being a conductor of heat force) is the cause of the central portion of a magnet being neutral; at this point, the force, as it proceeds round the bar, is transferred right and left from the centre to the adjacent molecules, and the tendency is to transfer the force to the poles, where the current is given off in greatest intensity, and decreasing from these points to the centre.

It has been noticed that the greatest power of a magnet does not reside in the extreme ends, but is situated at a short distance from them. This probably arises from the reflex action of conduction; the outer molecules of the ends being in contact with the surrounding medium.

A bar of steel, in its ordinary state, is receiving and giving off vibrations, in all directions, in the form of heat; but after the molecules have been induced to vibrate in one particular direction, the phenomena is changed to that of magnetism.

The compass takes its directive power from the currents of electricity proceeding round the earth, and places itself in the position of least resistance, according to the laws of attraction and repulsion.

The Earth, although acting like a magnet, is not magnetic in the ordinary sense of the word. It is rather an electro-dynamic globe; for the currents of electricity are produced by the action of the Sun, while the Earth is performing its daily revolution.

The Sun's apparent path on the Earth's surface, is the line which receives the greatest quantity of heat vibrations, decreasing on each side to the poles, and the point of greatest vibrations, will continually advance along this line, from east to west, and in this direction will the electric currents proceed. A compass placed on these currents, will be in equilibrium, when the vibrations on the side next the current of electricity is proceeding in the same direction.

Anything that tends to change the direction of the vibrations of magnets, destroys their magnetic properties. If a magnet is heated to a sufficiently high temperature, it loses all magnetism, for the molecules are receiving a greater quantity of vibrations, than can be carried off, and the mass is expanded and this enables the molecules to assume their ordinary position.

The varied effects of magnetism on electricity and the converse, are strictly in accordance with the theory here laid down, and it is entirely unnecessary to suppose, that there is either an electric, or magnetic fluid, as the molecules and the æther is the medium by which the force is propagated from one place to another.

METEOROLOGY.

The science of meteorology is so intimately connected with the phenomena of heat, light, and electricity, that no great progress can be made, until a connected theory of their operations is well established.

The first law to be recognised, that of gravity acting on all the molecules of matter, is applicable to the gaseous media surrounding the Earth, and according to this law, there will be a tidal action in the atmosphere, similar to that in the ocean, and this tide will not be perceptible by any known instrument, for all liquids being under the same influence, will show only their own motion; the barometer indicates expansion of the atmosphere by heat, but not the tidal action.

The laws, that all perfect gases have the same co-efficient of expansion, and that equal increments of heat produce equal expansion, is true in the limit only, for the force of gravity, and the force of heat, are opposing forces, and all gases are under their influence. Although the co-efficient of expansion is nearly the same; yet there is a difference, and this must be ascribed to the action of gravity. The most perfect table of expansion by heat is that of steam, where the increasing influence of heat, and decreasing influence of gravity, is clearly perceptible; but in the case of the most perfect gases, experiments have been made between small limits, and the influence of gravity overlooked.

In examining the changes which take place in the atmosphere, it will be seen that the varying action of the atmospheric tide, and the variation in the quantity of heat, which falls on any given district from day to day, will produce an infinite series of change, and a due consideration of this will explain many of the obscure points in this science.

The electrical condition of the atmosphere will readily be understood from what has been stated under electricity. The heat waves arriving at the surface of the ocean, communicate the motion to the surface, causing vapour of water to rise and mix with the atmosphere. This mixture of vapour and air is radiating the heat to the æther in space, and the vapour having the greater specific gravity is condensed into clouds. If the radiation takes place slowly, no electrical phenomena is perceptible, as the vibratory motion is imparted gradually to the surrounding media; but if radiation proceeds rapidly, the electrical phenomena of thunder storms is manifest.

When clouds are formed rapidly, the outer shell will be the most condensed, parting with its heat first, and, under the influence of gravity, the denser portion will gradually accumulate at the lower part of the cloud. As the conductive power will be considerably increased by condensation, the heat vibrations will be greatest in that portion which is the best conductor. If the cloud in this state comes near a good conductor, or near another cloud which is in a lower state of vibration, the heat force is thrown off to the nearest conductor, carrying with it some of the vesicles of water, and producing the phenomena of lightning, with its attending concussion of the air-thunder.

This phenomena takes place in a similar manner to that which is produced when an electric spark passes from one conductor to another. The condensation of the vapour into clouds decreases the conductive power of the air between them, and when two good conductors are brought near together the conductive power of the medium between the two is increased, and enables the heat vibrations to be given off in the form of electricity.

The neighbourhood of mountains is favourable to the production of storms. The Earth, acting as a conductor, in addition to the radiation into space, causes a more rapid condensation; and when this has reached a certain limit, the heat force is no longer carried off equally, but is thrown off spasmodically, as in the case of thunderstorms.

The electric condition of certain parts of the Earth's surface is caused by the intense dryness of the air in those parts, preventing the good conductors from throwing off their accumulated heat equally; and the Aurora Borealis is a phenomena of this kind, produced under conditions which will be described hereafter.

The rapid expansion and contraction of the air also produces gales, and local disturbances take place after severe thunderstorms. Hurricanes and cyclones partake of the nature of vortex systems on a very large scale, and their destructiveness arises from their vortex motion.

ASTRONOMY.

The science of Astronomy being based upon the laws of force and motion, has received a greater development than the previous sciences, but the doctrine of inertia is not explained in a satisfactory manner.

Inertia is a consequence of the action of external force on the molecules, and a body will only continue in motion so long as the two forces, gravity and heat, are acting upon it. But the doctrine of inertia implies something more than inability to move; the force in a molecule, which is not converted into vortex motion, is a force of resistance to gravity; and that portion of force which has apparently disappeared as vortex motion, and reappeared as gravity, is an opposing force to heat, in addition to that portion opposed to gravity, and this force of resistance, in a given space, will vary according to the specific gravity and vortex motion. Masses, therefore, cannot

move in space, or continue in motion, neither can they attract other masses, nor be attracted, in a manner which has hitherto been accepted as an explanation; but by transferring gravity to the æther in space, and the opposing force to that which is released from the vortex systems, their contending influence on bodies produce those varied movements which has been ascribed to attraction. As the stars and planets are built up of molecules, the same laws which explain the motions of a molecule explain those of the heavenly bodies.

Gravity is the phenomena of force manifested by the æther, which, acting upon the molecular systems, causes all bodies to tend towards one another, as previously explained; and the force of gravity cannot increase or decrease, otherwise than the square of the distance, from any given point, for this is the law of space. Gravity, of itself, cannot retain a body in motion, as is seen in the heavenly bodies: for, being a constant force, it acts with equal pressure in all directions, and the motion of two bodies under its influence alone would cease when they came in contact. But all bodies in Nature being also under the influence of heat, produces permanent motion as long as it continues; and any variation in the motion of a body is caused by the increase or decrease of the heat force. Gravity might be called a static force—that which brings bodies to rest; and heat, a dynamic force—which sets them in motion.

Whatever be the intermediate source of heat, the primary source is the force thrown out during the disintegration of the molecules, or what is called chemical combination; and the heat of the Sun is derived from this source.

Judging by the laws of chemical combination on the Earth, it has been shown by mathematicians that, if the sun was a solid coal, the combustion would be complete in 5,000 years, and no further heat produced from that source. Hence, it is maintained that the heat of the Sun cannot be kept up by combustion; but it has been overlooked that the products of combustion remain to be accounted for.

The force thrown out of the molecules during combination is a very small portion of the whole force; and, in the Sun, combustion proceeds further than on the Earth, and will go on until all the vortex systems are entirely disintegrated, for these vortex systems are forced together by the æther; and whenever they come in contact part of the force

is thrown out, which proceeds outwards in all directions, and ultimately joins the force in space. And combustion is not only going on between heterogeneous bodies, but homogeneous ones as well: hence it will be seen that so long as there are any molecules forming a central body, combustion must go on until the whole is reduced to the same state as the matter in space; for all bodies are gradually being reduced to their primitive condition.

The heat thrown out by the Sun, first acts upon its own molecules in retaining them partially asunder, in opposition to the force of gravity, which action will be greatest on the surface, and the wave character of heat, and light, as known on the Earth, is caused by the contending influence of gravity and heat acting upon them.

The apparent diameter of the Sun may be maintained, although the molecules are becoming less, as the condensation will depend to a certain extent, upon the rate of combustion, and facility for dissipation of the heat. That the heat of the Sun is declining must not be looked for in its apparent diameter, but will be seen in the gradual approach of those bodies revolving round it; for as the force of heat declines, the force of gravity pushes those bodies nearer to the source of the heat, and an observer situated on the Earth, will still have the same apparent size presented to his view.

It is already known that there is at least one body whose period of revolution is becoming shorter. The retarded motion of Encke's comet has been attributed to the æthereal medium which pervades space; but as all motion is the result of the action of gravity and heat, and gravity itself cannot be variable, it must be the diminished force of heat, which causes this comet gradually to approach the Sun, and ultimately to fall into it; and the Sun, being replenished by fresh fuel, will then send out heat with renewed energy. When this heat has been expended, the next nearest body will fall into it, to go through the same process, which will be repeated until the whole solar system is used up.

The approach of the planets to the Sun may be so gradual as to escape the refined analysis of observation, but if it has been detected in one body revolving round the Sun, then all others must come under the same law; but there is another cause which will also tend in some degree to maintain the Sun's heat, for the universe is filled with other

solar systems going through the same process, and their heat will retard the motion of our central orb, and contribute to its force.

The remarkable phenomena observed in a star, near Epsilon Coronal Borealis, can only be attributed to some body falling into that star and increasing its combustion. On the Earth, chemical combination goes on within a limited circle, for the Sun's heat, entering into the mass, retains the molecules apart, and thereby causes combination to take place within very small limits.

The motion of the planets round the Sun is a tangential motion, produced by the force of gravity and the force derived from the Sun's heat, and their path is the line of equilibrium, where the two forces are balanced in the body under their influence. During the passage of heat from its source into space, the force appears under two aspects when it comes in contact with bodies, that of molecular motion and the motion of masses. In the case of molecular motion, the force of gravity is not strong enough to hold the molecules together in a compact mass, and the heat passing through causes the molecular motion, which is most clearly noticed in gases and liquids. In the case of masses, the force of gravity is strong enough to retain the molecules together, and the heat force moves the whole mass rather than produce molecular motion, although all bodies have molecular motion in some degree.

The action of the two forces upon a planet are of a different nature. The lines of force for gravity may be described as proceeding from the circumference of a circle to the axis, where the planet is supposed to be placed; but the lines of heat force proceed from its axis, the Sun, to the circumference of a circle, and if these lines are extended to the planet, the lines of the two forces do not coincide, and an unstable equilibrium is produced. It is to this cause that a planet revolves round its primary, and its daily revolution is referable to the same, as well as the motion of moons which are revolving round a planet.

The general characteristics of planets is a consequence of the conditions under which the solar system has been condensed. It is not known how the vortex systems have been formed in the first instance, but it is exceedingly probable that they were called into existence separate, and scattered over the universe, or may have filled it. In the order of time, these vortex systems have been collected into molecules, and these again into distinct centres, constituting the different solar systems.

The solar system of which the Earth forms part has orginally been a gas, or nebulous body, and condensed by the action of gravity. At certain periods of condensation, crusts of matter have been formed round the nucleus, which have not transmitted the heat sufficiently fast through their molecules, and they have been thrown off by the force of the heat and projected to a distance, where the force of heat and gravity produced equilibrium. In the same manner the moons have been formed from their primary. In Saturn's rings we have a case where the matter has been thrown off, but the heat force has not been sufficiently great to break the rings and enable them to form moons round their primary, and is left for a memento of an arrested operation in nature. The revolution of all planets is in the same direction as the diurnal motion of the Sun, and this could only be produced by the force of heat being projected on the same lines, and that the same cause has produced the whole of the planets and satellites.

Comets are bodies that have little or no solid nuclei, and are principally composed of gaseous matter. These bodies probably did not originally belong to the solar system, but were brought in by gravity, and their path round the Sun is the result of the action of heat. A comet in space, out of the influence of solar heat, will be a nebulous mass. As it approaches the Sun, the path would be a direct line to its centre; but coming under the influence of solar heat, and not being a solid body, the heat force is taken up in the form of molecular motion, and the lightest portion of the gaseous matter is retarded, and thrown out in the form of a tail, which is their chief characteristic. On its nearer approach to the Sun, the heat force acting on any solid matter that it may contain, overcomes the force of gravity, and instead of plunging into the Sun, it sweeps round in a very short curve, carrying its tail round on the opposite side to the source of heat, or sending out a new one. The reason why the path of a comet and a planet differs arises from the one being nearly all gaseous matter, and the other solid.

While the Sun is throwing out this intense heat, no smaller body can fall into it, as the force of heat would overcome that of gravity.

The sun-spots are caused by the action of the planets surrounding the Sun, and is a phenomena of induction. The Sun's atmosphere will collect in greatest quantity on that side on which there is the

greatest preponderance of planets at any time, and on the opposite side will be the least quantity. These spots have been connected principally with the motion of Venus and Jupiter. On the side next these planets the luminous vapour will collect in greatest quantity; and if the Earth is situated on the opposite side of the Sun, it faces that portion of surface which has a less quantity of luminous vapour, and exercising its inductive influence, increases the rate of absorption of luminous vibrations; and the luminous vapour, being deprived of heat faster than it is received from the body of the Sun, becomes condensed in patches, and less heat will apparently be received from these regions; but if the vapour be so condensed as to show the dark body of the Sun, a more open passage is left for the Sun's heat to radiate into the æther, and a greater quantity will be given off. The Sun's heat is therefore much more variable from these spots than from that which comes through the luminous atmosphere. These unequal waves, on arriving at the Earth's surface, produce the so-called magnetic storms; for when there are no spots on the Sun, the heat arrives on the Earth's surface with a regular force, but when spots appear, the force becomes irregular and variable in character, producing irregularity in the flow of the electric currents round the Earth, which, in its turn, produces the irregular action of magnets, under the conditions already explained.

The Aurora Borealis is also caused by these variations in the flow of the electric currents, as the tranquil condition under which the heat force is dissipated at the poles is affected in like manner. In these regions the aqueous vapour exists principally in the form of frozen particles or spiculæ, and the sudden increase of heat sets the particles in increased rotation on their axis sufficiently fast to produce light.

The light which is thrown out by the Sun is a consequence of the action of heat on those clouds which form the Sun's photosphere. Its outer atmosphere is composed of matter whose molecules have the lightest specific gravity, and they will have the greatest amount of molecular motion and less rotary motion, throwing out the greatest quantity of heat waves. The photosphere is composed of molecules of much heavier specific gravity, which have less molecular and a greater rotary motion, throwing out waves of light.

It appears to be, when bodies of heavy specific gravity are in the

state of vapour, combined with sufficient heat, that light is emitted, and its production in the Sun takes place under the same conditions as in the electric light—by the rotation of the molecules. Those bodies of light specific gravity pass easily into the gaseous state on the application of heat, and emit little or no light; but bodies of greater specific gravity require more heat force to vaporise them, and pass through the changes more slowly, and the path of their motion being much restricted, they are enabled to emit shorter waves. The field of spectrum analysis will give great insight as to the rotation of the molecules; for the angular motion round their axis of rotation will be the length of the wave; and their number of revolutions in a given time, the number of waves in the same period.

The motion of double stars is also in accordance with the theory that each is throwing out heat force, which causes them to revolve round one another.

HEAT AND WORK.

The mechanical theory of heat would be much simplified, if heat (in the ordinary acceptation of the term) was called the molecular motion of heat, and work, the mass motion of heat; it would then be clearly seen, that the change of heat into work, was the change of motion in an infinite number of directions, into motion in one particular direction, both are work and both are motion.

The heat force after leaving its source never returns to it again, but proceeds outwards until equilibrium is established in space. During its passage, it may be changed into molecular motion, from that to mass motion, and again to molecular motion, but whatever course it goes through, it ultimately finds it way out, in the form of radiant heat, and there is no cycle of operations returning into the same, but one beginning and one end.

The first law of thermo-dynamics indicates the conversion of molecular motion into mass motion, and the second law states, that whatever quantity of molecular motion be converted into mass motion, the same quantity is reconverted into molecular motion, but the phenomena is one continued flow of force, from the seat of combustion to the æther in space.

The different forces have been spoken of, as separate forces, and it

has been shown how they all originate out of one power, which has been called the matter in space; but, in order to describe their operation, it has been necessary to speak of them as separate forces.

Force is a manifestation to the senses of the power of space, and motion is the disappearance of force in one portion of space and re-appearance in another, and is only manifest by the molecular arrangement of bodies, for wherever force exists, motion is coeval with it. If this molecular arrangement was destroyed, both force and motion would cease to be manifest, for this power would be in equilibrium with itself.

In order to produce motion, it is necessary that one force should be greater than another, and as the greater force, in its progress from a given point, spreads out in the ratio of the square of the distance, so it ultimately comes to equilibrium with the force in space, and forms part of it, and a succession of motion can only be kept up by a constant accession of heat force.

The conservation of force does not consist in the conservation of energy of the molecules, but of one indestructible power which is never changed but manifests itself in innumerable forms. As nothing is known of the power of space, it cannot be known whether the absolute force of gravity is increased by this constant addition of force to it; but from the operation of the laws of Nature, it may be infered that a time will come when all bodies are dissipated, and transformed into that infinite and eternal Power, which pervades space, unless a new succession of vortex systems are brought into being.

In the operations of Nature, antagonism is the fundamental law, and attraction, or affinity, the law of least antagonism.

The foregoing theory has been constructed without reference to measure of either force, motion, or size (as this subject belongs rather to the devolopment of science into its various branches); and also excludes a consideration of the phenomena of life. It claims to be a nearer approximation to the truth, but not entirely free from error, and there may be a considerable amount, in the descriptive detail, having been developed without the aid of mathematical formula. But if it be granted that force is a manifestation of that Infinite Power, which no man can comprehend, then a basis is obtained which will be a foundation for all science.

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